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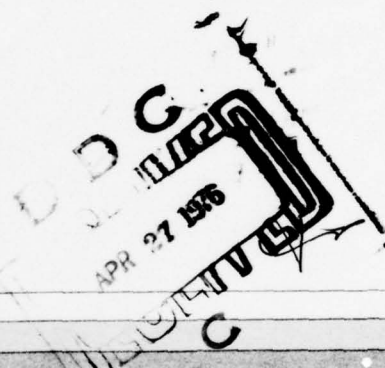
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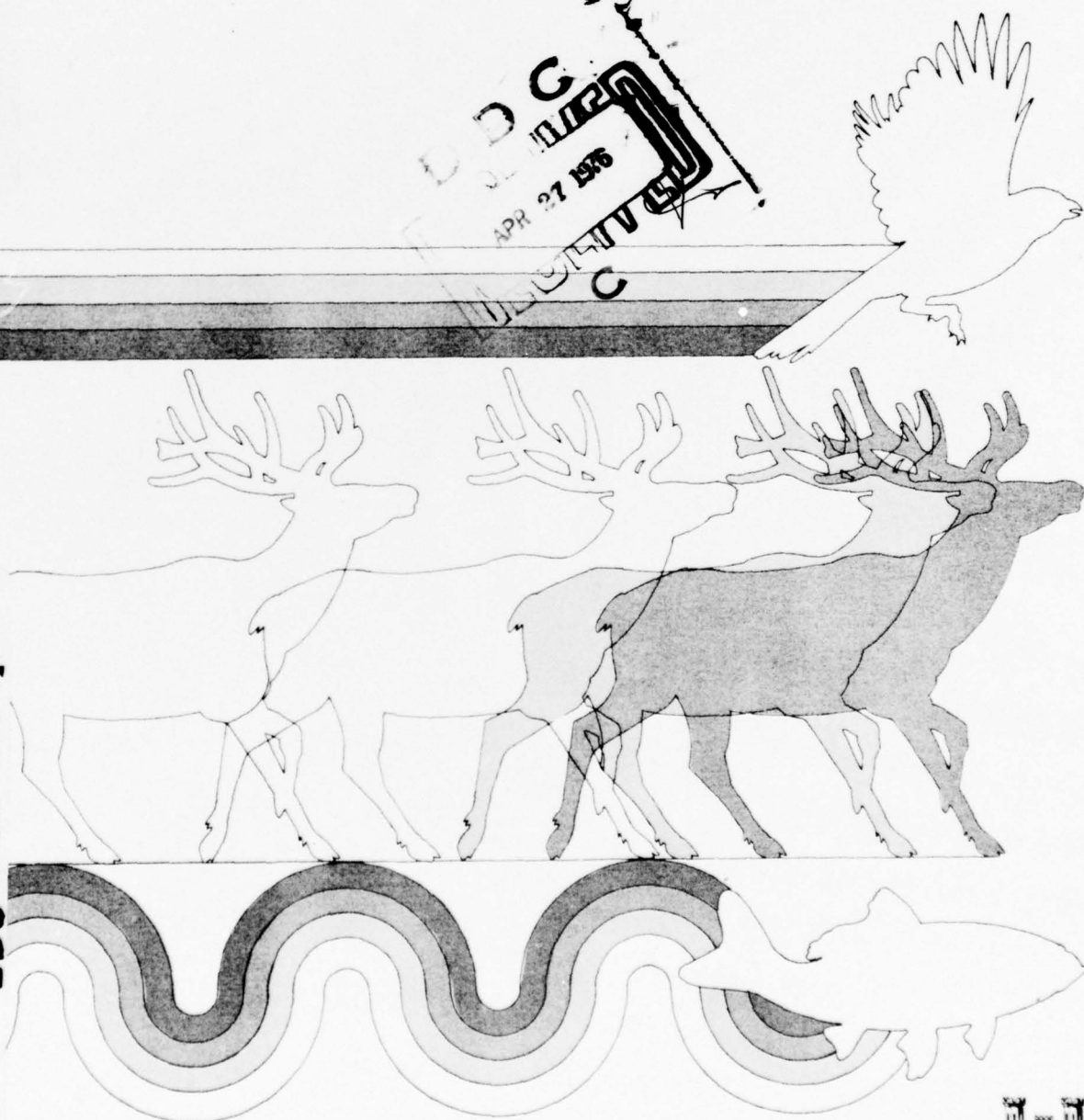
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⑤ Evaluation
of Planning for
Fish & Wildlife

Littleville
Reservoir Project
October 1976



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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) → Littleville Reservoir is located on the Middle Branch of the Westfield River, Mass. within the Towns of Chester and Huntington, Massachusetts. The project was authorized in 1958 to provide flood control and water supply benefits. The reservoir, which was completed in 1965, covers 111 ha at water supply elevation and 206 ha at full flood pool. The total project includes 680 ha of land and water. (cont on p 1473 B)		

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by

In their November 27, 1961 planning report, the FWS recommended that hunting be permitted on project lands but did not recommend any alternative action if the lands should be closed to hunting. Thus, subsequent action of the City of Springfield closing the project lands to hunting, resulted in an unmitigated loss of hunting potential on 680 ha of publicly owned lands.

It was anticipated that the locally important trout fishery supported by a section of the Middle Branch of the Westfield River 4 km in length would be replaced by a reservoir trout fishery. The reservoir fishery was expected to attract approximately 100 angler-days per acre per year. State creel survey records indicate that the actual use of the established reservoir trout fishery, five to seven years after impoundment, averaged 46 trips/acre. The CE estimate of angling pressure averaged 2.7 times greater than the State estimates. Angling pressure was supported by a relatively small number of trout (approximately one-half catchable trout was planted per angler-day). This low trout stocking rate possibly was responsible for the lower than expected post-impoundment angling pressure.

but

With the exception of a request for cold water releases, the FWS report did not adequately consider the downstream fishery resource. The CE has not operated the reservoir so as to provide the requested cold water releases.

In general, cooperation and coordination between the State and Federal agencies were inadequate during both pre-construction and post-construction periods.



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Personnel in the environmental planning and recreation management elements of Corps agencies should review this report with a view towards improvement of Corps activities.

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SPORT FISHING INSTITUTE

PROJECT PERSONNEL

Norville Prosser (Assistant Project Leader)

Robert G. Martin (Project Leader)

Richard Stroud (Contractor's Representative)

INDIVIDUAL RESERVOIR PROJECT EVALUATION REPORTS

THE LITTLEVILLE RESERVOIR PROJECT

INTRODUCTION

Location

Littleville Dam is on the Middle Branch of the Westfield River approximately one mile above the confluence with the Westfield River. The Reservoir is located within the Towns of Chester and Huntington, Massachusetts. These towns are in Hampshire and Hampton Counties. Littleville Reservoir is located in and operated by the New England Division, U.S. Army Corps of Engineers.

Authorization

The Littleville Reservoir project was authorized by the Flood Control Act of July 3, 1958 (Public Law 85-500, 85th Congress, 1st Session) as recommended in Senate Document No. 17, 85th Congress, 1st Session. Littleville Reservoir represented an addition to the comprehensive Connecticut River Basin flood control plan which was authorized by the Flood Control Act of 1938 (Public Law 561, 75th Congress, 3rd Session) as modified by the Flood Control Act of 1941 (Public Law 228, 77th Congress, 1st Session) and the Flood Control Act of 1944 (Public Law 534, 78th Congress, 2nd Session). Authorization of features to provide a future water supply source for the City of Springfield, Massachusetts was provided under the Water Supply Act of 1958 (Public Law 85-500, 85th Congress, 1st Session) (1).

Littleville Reservoir is a dual-purpose structure, providing flood control and water supply benefits. Flood storage provides flood damage reductions on the Westfield and Lower Connecticut Rivers. The project was designed

to provide flood protection for the City of Westfield, Massachusetts, located approximately 19 km (12 mi) below the dam. By contract dated December 13, 1967, the City of Springfield, Massachusetts, acquired water supply rights to Littleville Reservoir. Actual use of the reservoir for water supply has not yet begun. Payments for use of the impoundment for water supply will begin when water supply diversion actually occurs (2).

Physical Features

Construction of the dam was initiated in June, 1962, and completed in September, 1965. The cost of the project totaled \$6,882,000 including \$2,100,000 for water supply features. The dam, 414.5 m (1,360 ft) long and 50 m (164 ft) high, is a rolled earth and rockfill embankment. The retarding structure also includes a dike, 254.4 m (835 ft) long and 14 m (46 ft) high. The crest elevation of the dam and dike is 181.7 m (596 ft) mean sea level (msl). The chute type spillway has a weir 121.9 m (400 ft) long, with crest elevation at 175.6 m (576 ft), msl.

The reservoir was constructed with two separate controlled outlet systems. A water supply outlet facility provides four 0.91 m (36 in) multi-level sluice gates at 136.2 m (447 ft), 142.0 m (466 ft), 147.8 m (485 ft), and 153.6 m (504 ft) msl. The flood control outlet works consist of an intake channel 6.1 m (20 ft) wide, excavated in rock to 157.0 m (515 ft) msl. Flood water releases are regulated by two sluice gates. At full flood storage of 175.6 m (576 ft) msl, Littleville Reservoir has a storage capacity of $4.0 \times 10^7 \text{ m}^3$ (32,400 ac-ft) and covers 206.4 ha (510 ac). The water supply component, below elevation 157.9 m (518 ft) msl, includes $1.2 \times 10^7 \text{ m}^3$ (9,400 ac-ft) of storage, covers 111.3 ha (275 ac) and has a maximum depth of 26.2 m (86 ft) (2). Land acquired for the project

totals about 680 ha (1,680 ac). Figure 1 illustrates the Littleville Reservoir and project lands.

Littleville Reservoir is operated in conjunction with Knightville Reservoir to reduce flood conditions in the Westfield and Connecticut Rivers. During normal flows, the overflow weir at elevation 157.9 (518 ft) msl maintains outflow. Flood control operations are designed to delay flood peaks for a period of several days and to moderate the flood peak intensity.

Area Description

The project is located in a rural, sparsely populated but readily accessible section of the state. The watershed is characterized by wooded hills with steep slopes and narrow valleys. Vegetative cover consists largely of mixed hardwood and softwood species. Precipitation averages 117 cm (46 in) per year in the vicinity of the dam, and average temperatures range from -2°C (24°F) in January to 21°C (70°F) in July (1).

Although most of the manufacturing industries are concentrated in Westfield and West Springfield, Massachusetts, economic activities within the project area include some light industries within the smaller communities of the watershed. Little agricultural industry remains. Summer residences and recreational activities, and related businesses, have increased in the immediate area of the reservoir.

Descriptive Reports

Reports, documents, and correspondence pertaining to the pre-impoundment assessment of the probable impact of Littleville Reservoir on the area's fish and wildlife resources and the development of recommendations to protect or enhance these resources were examined at several locations.

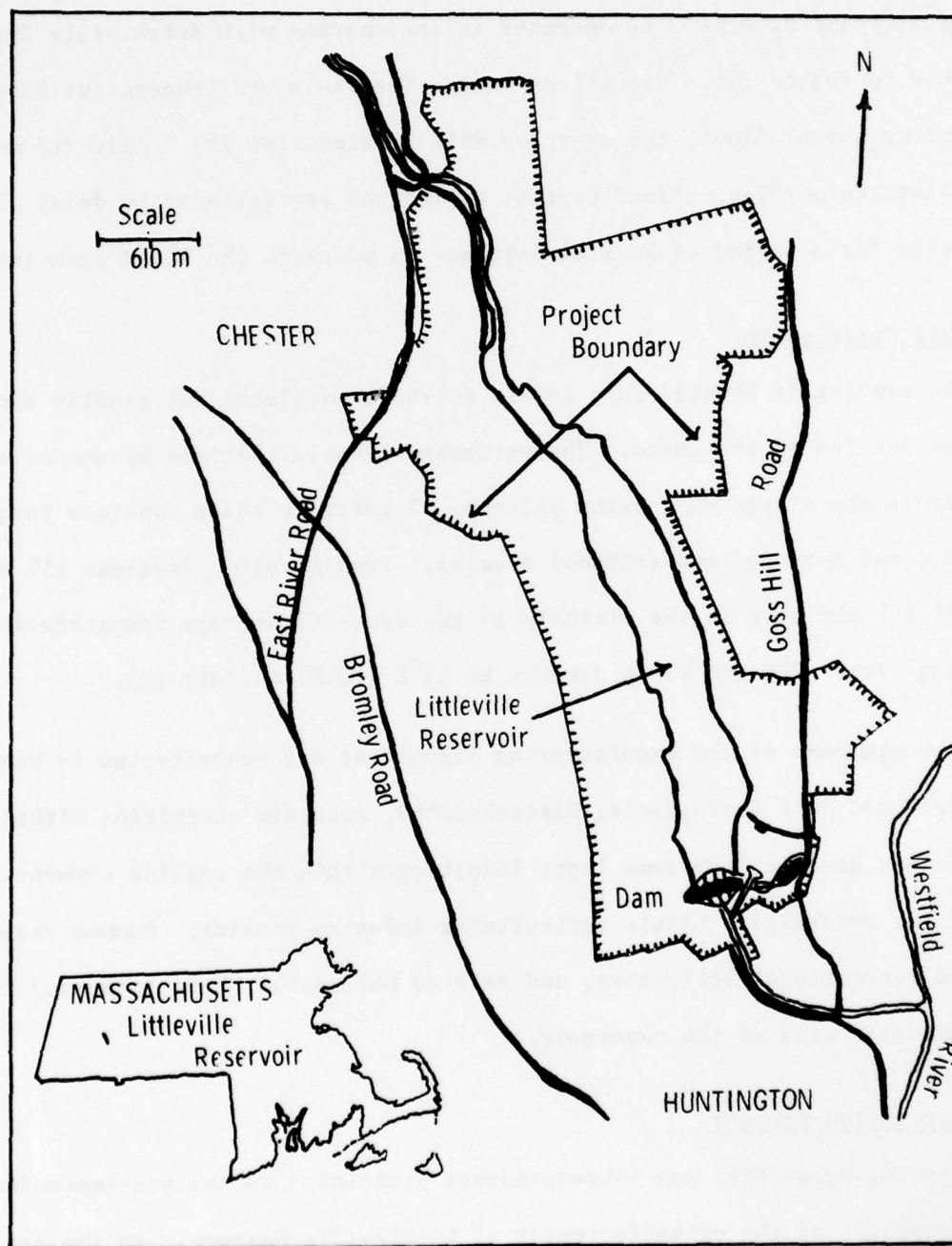


Figure 1 -- Littleville Reservoir and associated project features.

Littleville project records filed by the U.S. Fish and Wildlife Service (FWS) in the National Archives in Washington, D.C. were reviewed initially. These files proved to be of little value to the investigation. The field office of the FWS, Division of River Basin Studies, located in Concord, New Hampshire, was responsible for the Federal fish and wildlife planning assistance on the project. The Concord office was visited, as was the field office of the Massachusetts Division of Fisheries and Game (MDFG), in Westboro, Massachusetts. The reservoir was visited and project features were discussed with knowledgeable state biologists and Corps of Engineers (CE) staff.

At the time the project received Congressional authorization (1958), only preliminary FWS comments were available, (3), viz:

This flood-control project is located in a narrow steep-sided portion of the Middle Branch of the Westfield River Valley. Most of this portion of the scenic valley is wooded. The stream is clear, fast flowing and unpolluted. This is a very important trout stream and one heavily used by fishermen. Although several wildlife species range over the site, aggregate wildlife values are low. Greatest resource values are attached to the trout fishery of the area. Should the project be operated as a dry-bed unit some of the fishery values within the area would be retained. However, during periods of floodwater retention some damages could be expected. The downstream fishery would benefit from regulated flow during periods of high runoff. At no time should the downstream reach be completely dewatered. No significant change would occur to the wildlife resource.

The only substantive fish and wildlife planning document prepared by the FWS was submitted to the CE on November 27, 1961 (4), only seven months prior to the beginning of construction. This report provided several development and operational recommendations which, it was believed, would maximize the fish-and-wildlife-related recreational potential of the project. The impact of the reservoir on the area's game and fish populations was discussed, and projections of man-days use were provided. A follow-up

report of the Littleville project was prepared by the FWS in cooperation with the MDFG in 1973 (5).

Post-impoundment fisheries investigations were conducted by the MDFG on Littleville Reservoir during the 1968 to 1971 fishing seasons. Typical of the smaller projects in this area, little post-impoundment wildlife evaluation has been conducted (6). Evaluation of the project's impact on game and fish resources is primarily aimed at the fisheries aspects.

RESULTS AND DISCUSSION

Wildlife Resources -- Pre-impoundment Predictions

Wildlife resources of the Littleville project area were presented in the November 27, 1961, report as follows (4):

Several wildlife species range over the project area. However, their aggregate values are low. The only big game animal present is the white-tailed deer. Upland species include varying hare, gray squirrel, cottontail, ruffed grouse, raccoon, and woodcock. A few pheasants are stocked in the limited suitable agricultural coverts. A small number of furbearers, including muskrat, mink, and beaver, is found in the valley. Deer-hunting pressure is heavy throughout the valley, whereas hunting pressure on upland species is light.

Impact of reservoir construction on wildlife resources was not expected to be significant. The planning report stated:

The loss of wildlife habitat by the inundation of 275 acres is expected to be insignificant. The permanent pool will probably attract migrating waterfowl and provide some opportunity for waterfowl hunting. Of greater significance for future use is the opportunity to assure public access for hunting on approximately 1,000 acres to be taken in fee excluding the dam site and the permanent pool area.

Several comments relating to the wildlife resources of the project were made in the discussion section of the planning report. The pertinent statements are reproduced below:

The State Division of Fisheries and Game and this Bureau believe that hunting and fishing on watersheds are compatible with the use of the watershed for domestic water supplies. A significant loss of fish and wildlife utilization would result if the Littleville Reservoir and its watershed were closed to hunting and fishing when the permanent pool is utilized for domestic water supplies.

* * *

It is estimated that project lands, excluding the permanent pool, the dam site and an area reserved for reasons of safety, efficient operation, or protection of public property, would total about 1,000 acres. While intensive wildlife management on these lands is not practical due to rugged topography, the existing wildlife resource is important because it provides a

considerable amount of hunting opportunity. Although it is felt that the existing resource could not absorb much more hunter pressure, the loss of the existing opportunity would be significant, especially in view of the proximity of several cities with large populations. The permanent pool would also provide some benefits by increasing opportunity for waterfowl resting and feeding and for a small amount of waterfowl hunting. Project lands and waters should be made available to the Massachusetts Division of Fisheries and Game for fish and wildlife management purposes as a public hunting and fishing area under a General Plan for fish and wildlife management.

The 1961 planning report contained eight project developmental and operational recommendations. Two closely related recommendations focused specifically on the wildlife aspects of the Littleville project, viz:

- (1) That project lands and waters be open to free use for hunting and fishing except for sections reserved for safety, efficient operation, or protection of public property.
- (2) That project lands and waters be made available to the Massachusetts Division of Fisheries and Game for fish and wildlife management purposes in accordance with a General Plan as provided in Section 3 of the Fish and Wildlife Coordination Act, except for sections reserved for safety, efficient operation, or protection of public property.

At no juncture in the predictive report were quantitative values of hunting use of the proposed project lands provided. The only reference of use was the statement that:

The 1960 National Survey of Fishing and Hunting revealed that in New England 14% of the population fished and 6% hunted. This indicated that there was a potential of over 70,000 fishermen and 30,000 hunters within a 30-mile radius of the project.

Wildlife Resources -- Post-impoundment Occurrences

The City of Springfield, Massachusetts, received authorization from the State Legislature in 1961 to modify the Littleville project so as to provide additional domestic water supply. A contract between the United States Government and the City of Springfield, dated December 13, 1967,

gives the city the right to use Littleville Reservoir water between elevation 518 ft and 432 ft msl for water supply (2). Shortly thereafter, the city adopted regulations to protect the quality of their future water supply at Littleville Reservoir. One measure adopted was the prohibition of hunting on project lands.

As a result of this regulation excluding hunting, no post-impoundment wildlife studies have been conducted and only minor attempts at wildlife management have been carried out. At the present time, the only wildlife management program at the Littleville project is an attempt to establish a new Canada goose breeding ground. Goslings were released at Littleville Reservoir by the MDFG in 1973 (33 released) and in 1974 (24 released). Five adults returned to the lake in 1974 and three adults returned in 1975. Successful nesting has not yet occurred (7).

Although hunting is not legally permitted on project lands, CE records indicate some hunting occurred each season from 1966 through 1968 and in 1971. The average number of annual hunting trips reported by the CE for the years 1966 to 1971, inclusive, was 353 trips. Because hunting is not officially allowed at the project, no record of hunting activity has been maintained since 1972 (8).

Wildlife Resources -- Evaluation of Planning Input

The wildlife planning effort at the Littleville project was not adequate. In November, 1962, one year after submission of the FWS planning document, the MDFG requested the CE to acquire lands lying between the Littleville project boundary and the Chester Wildlife Management Area (9), owned and operated by the State. There was little coordination between the agencies, as the FWS was not included in the deliberation on acquisition of the

approximately 600-acre tract (10). Documentation of further action on this land acquisition proposal is lacking (11), but no land was purchased for wildlife purposes at the Littleville project.

The 1961 report contained references to the potential loss to the area's wildlife resources if the project lands were closed to hunting. The report specifically recommended that project lands be open for public hunting. However, acquisition of the replacement lands, in the event that project lands were closed, was not mentioned in the 1961 FWS report. Subsequent closure of project lands to hunters, by the City of Springfield, resulted in an unmitigated loss of hunting opportunity on approximately 680 ha (1,680 ac).

In its 1973 follow-up report, the FWS mistakenly reported that the 1961 recommendation, to open Littleville project lands to hunting, was incorporated in the operation of this project (5). This erroneous statement also received concurrence by the MDFG. This lack of attention to detail appeared to characterize the wildlife considerations for this small flood control and water supply impoundment.

Fisheries Resources -- Pre-impoundment Predictions

The fishery aspects of the Littleville project were addressed in much greater detail than were the wildlife aspects in the 1961 FWS conservation and development report. Since the reservoir was expected to be tapped around 1980 as a water supply source for the City of Springfield, Massachusetts, the 1961 report developed the fisheries aspects of the project only for the interim period. A further report was promised prior to initiating use of the reservoir for water supply purposes.

The pre-impoundment sport fisheries discussion of the Middle Branch of the Westfield River was based on a 1952 creel survey conducted by the MDPG. This important trout fishery was described as follows:

The Westfield River and its branches and tributaries are trout streams of statewide importance. The Middle Branch is of particular importance and is heavily used by stream fishermen. The use is attributed to three factors: very good access from paved roads, sizeable portions of the stream under lease by the State, and a heavy fish-stocking program. Approximately 11 miles of land bordering the stream are leased by the State for public angling, of which 3.4 miles are within the project area.

The Middle Branch now supports approximately 20 pounds of fish per acre, and is stocked each year with 15,000 catchable size trout. The Middle Branch within the town of Chester is stocked with an average of 4,200 trout annually, based on available figures for the past 10 years. Fishing pressure is heavy from opening day (third Saturday in April) to Memorial Day and tapers off to the middle of June after which there is very little fishing effort. The chief factors for the decline and absence of fishing during the summer months are low stream flow and warm-water temperatures which are unsuitable for trout.

The State Division of Fisheries and Game conducted a creel census of the Middle Branch in 1952. This census revealed that there was a total of 2,500 individual fishing trips that year of which 2,307 were made before June 15. The fishing pressure averaged 156 angler trips, or 406 hours of fishing per mile.

The FWS assigned an annual sport fishery value for the 15.4-mile reach of the Middle Branch of \$7,500 or \$486 per mile. This value was derived by applying the Inter-Agency Committee on Water Resource's maximum value of \$3.00 per angler-day for the cold-water stream fisheries to the 1952 data.

Replacement of a segment of the stream with a lake fishery was expected to improve the overall fisheries resources. These expected changes were described as follows:

Construction and operation of this project will be detrimental to the existing fishery resource during the actual construction

phase and possibly afterwards, depending upon the method of reservoir operation. Some damages to the habitat from siltation downstream from the dam site as a result of construction operations, including the removal of topsoil, are usually unavoidable.

Within the permanent pool, 2.5 miles of the Middle Branch will be permanently inundated and lost. Up to 0.9 additional miles of stream would be lost temporarily while the reservoir is storing floodwaters.

It is expected that the permanent pool will provide suitable habitat for trout. This will produce major benefits to the fishery resource which will more than compensate for losses to the stream fishery. The Division of Fisheries and Game has found that fishing pressure on ponds managed for trout exceeds 200 hours per acre while pressure on warm-water ponds averages 50-60 hours per acre per year. A 127-acre trout pond, lying a similar distance from population centers as the Littleville Reservoir site, provided 38,656 fishing hours or 304 hours per acre, during one season. It has also been found that the average fishing day is 3.1 hours. It is anticipated that fishing pressure on the 275-acre permanent pool will amount to at least 83,600 hours per year, or about 27,000 angler-days per year. Applying the figure of \$3.00 per angler-day, the reservoir fishery will have a recreational value of \$81,000 per year.

Until the reservoir is used for water supply, the pool level will be maintained by releasing incoming flows from the pool surface at elevation 518. The temperature of the warmer surface water will probably be above the optimum for downstream trout survival and growth. However, this would probably not significantly affect downstream trout fisheries since, under existing conditions, stream temperatures reach high levels.

The 1961 FWS report contained eight recommendations, all of which related in one degree or another, to the fisheries resource. The eight recommendations were:

- (1) That project lands and waters be open to free use for hunting and fishing except for sections reserved for safety, efficient operation, or protection of public property.
- (2) That public access and boat-launching facilities be provided at Federal cost in the vicinity of the dam site and at the upstream end of the reservoir.
- (3) That motors on boats using the permanent pool be limited in size to a maximum of 10 horsepower.

- (4) That chemical reclamation of the Middle Branch above the dam site be carried out by the Massachusetts Division of Fisheries and Game after construction is completed.
- (5) That a minimum instantaneous discharge into the Middle Branch be provided equal to the natural flow or 100 cubic feet per second, whichever is less; this flow to originate at elevation 466, until such time as the reservoir is used for water supply.
- (6) That operation of the reservoir be re-evaluated and modification made cooperatively by this Bureau, the Massachusetts Division of Fisheries and Game, the City of Springfield, the Water Resources Commission, and the Corps of Engineers, as is found necessary after the project is operating, and prior to use of the reservoir for water supply.
- (7) That project lands and waters be made available to the Massachusetts Division of Fisheries and Game for fish and wildlife management purposes in accordance with a General Plan.
- (8) That additional detailed studies of fish and wildlife resources affected by the project be conducted as necessary during further planning and construction phases of the project to form a basis for such reasonable modifications for the conservation and development of fish and wildlife resources as may be desirable to obtain maximum over-all project benefits.

Each of the recommendations were discussed in somewhat greater detail in the discussion section of the report. Most of the recommendations need little explanation; however, the downstream-flow recommendation was complicated. The basic considerations for the recommendation were that, during the 49-year period of record, the annual average stream flow in the Middle Branch was 104 c.f.s., generally ranging from 0 to 100 c.f.s. during the critical summer and early fall months. Low summer flows and high stream temperatures were the limiting conditions with respect to trout survival. The report indicated that Littleville Reservoir water released from the 466 ft elevation gate (52 ft below the surface), would be of sufficiently low temperature to benefit downstream trout habitat. The FWS recommended that first priority go to the reservoir, however, and not to

the downstream fishery, viz:

To accomplish maximum possible fisheries benefits in the permanent pool and downstream, a reasonably stable pool level should be maintained and water should be released through the gate at elevation 466. We understand that this gate can be used until such time as water supply goes into effect. The gate should be operated to pass not more than 100 cubic feet per second when inflow exceeds this amount. Water in excess of 100 cubic feet per second would be released through the outlet works at elevation 518. When inflows are less than 100 cubic feet per second, the gate should be operated to pass an amount equal to the inflow. Thus, when there is no inflow, no water would be released from the gate. Flows in the Middle Branch equal 5 cubic feet per second or less about 4 percent of the time on the average, or about 15 days per year. When the flow reaches zero, any stream fishery remaining in the mile of stream between the dam and the main stem would be practically eliminated. However, the reservoir pool level would be maintained.

If cold-water releases improve habitat conditions downstream from the dam site as anticipated, it is estimated that fishing pressure will increase approximately 25%. There are approximately nine miles between the proposed dam and the dam at Woronoco. If stream conditions improve throughout this reach, it is expected that angling benefits will be valued at \$1,000 per year assuming existing fishing pressure is similar to that found on the Middle Branch.

The angler-use estimate for Littleville Reservoir was based on MDFG studies at the 127-acre Comet Pond, which is located near Worcester, Massachusetts. According to the MDFG, this trout pond received approximately 100 angler-days per year. The State anticipated that Littleville Reservoir would receive angling use of similar intensity (12). The FWS used the 100 trips/acre figure and multiplied by 270 to arrive at the predicted figure of 27,000 angler trips per year.

Fisheries Resources -- Post-impoundment Occurrences

Fisheries management at the Littleville project began when the streams within the lake site were chemically reclaimed by the MDFG to eliminate non-game fish. This reclamation was undertaken in 1965 as the lake was being filled. Reinfestation of the reservoir by non-game and warmwater

fish was first noted in 1966 when white suckers were identified as lake residents. Brown bullheads were captured in 1968 and in 1969, sampling of the reservoir produced yellow perch, golden shiner, common shiner, creek chub, fall fish, banded killifish, and pumpkinseed sunfish.

Trout stocking records were provided by the MDFG for each year since 1968 (13). Accordingly, the reservoir management plan initially implemented included stocking both catchable and fingerling trout of various species (Table 1). According to the records, 119,620 trout were planted in the lake between 1968 and 1975. Most of the planted trout were rainbows (60 percent), and just under one-half (45 percent) were six inches or larger. Littleville Reservoir has been planted with an average of 5,590 catchable trout (greater than 9 inches) each year. Of the 65,450 fingerling trout which have been planted, 55,450 (85 percent) were planted in 1969.

As early as 1967, when Littleville Reservoir was lowered to permit alterations to the dam, the City of Springfield, Massachusetts, began actively to discuss diversion of the reservoir for water supply. In this event, the city anticipated enacting regulations which would prohibit fishing.

As a reclaimed trout pond, fishing was permitted at Littleville Reservoir only during the regular open season for trout, approximately from the middle of May to the middle of October. Littleville Lake was withdrawn from reclaimed trout pond status in 1971, thus allowing the fishing season to extend through February in subsequent years.

The MDFG initiated a creel survey on September 1, 1968, to document the popularity and value of this important fishery, which was being threatened with closure. The survey was conducted for the three consecutive angling

Table 1 .--Species, numbers, and sizes of trout planted in Littleville Reservoir (1968-1975)

Year	Brook trout			Brown trout			Rainbow trout			Total trout		
	<6 in.	6-9 in.	>9 in.	<6 in.	6-9 in.	>9 in.	<6 in.	6-9 in.	>9 in.	<6 in.	6-9 in.	>9 in.
1968	-	-	40	5,000	1,000	40	-	3,000	3,040	5,000	4,000	3,120
1969	26,450	-	-	-	-	2,000	29,000	3,000	1,400	55,450	3,000	3,400
1970	-	-	-	-	-	-	-	-	6,650	-	-	6,650
1971	-	-	-	-	-	2,000	-	-	4,050	-	-	6,050
1972	-	-	-	-	-	3,950	-	-	4,750	-	-	8,700
1973	-	-	-	-	-	1,000	5,000	-	4,900	5,000	-	5,900
1974	-	-	3,000	-	-	300	-	2,000	2,700	-	2,000	6,000
1975	-	-	1,500	-	450	-	-	-	3,400	-	450	4,900
TOTALS	26,450	0	4,540	5,000	1,450	9,290	34,000	8,000	30,890	65,450	9,450	44,720

seasons (mid-April to mid-October) of 1969-1971 (14;15;16). Angling pressure varied from 13,222 trips in 1969 to 11,495 trips in 1971. Angler use averaged 12,561 trips for the three seasons. The principle investigator responsible for the Littleville Reservoir creel studies did not place statistical confidence limits on the various estimates. When queried on the subject, he indicated that in his judgment, ± 20 percent might be reasonable. According to the same individual, angling pressure may have increased slightly after 1971, but was probably declining at present due to the closure of nearby military installations.

According to findings of the State surveys, the number of trout harvested varied greatly from year to year (Table 2). In 1969, a total of 12,020 trout weighing 1,078 kg (2,377.5 lb) were harvested. In 1971, fishermen harvested 5,477 trout weighing 1,381.7 kg (3,046.2 lb).

Angling pressure and angling quality are related to the number and size of trout planted. The MDFG stocking records and creel survey data reflect a stocking rate of approximately one-half catchable trout per angler-day during the three years of the survey (1969-1971). More intensive stocking would undoubtedly have resulted in an increase in angling pressure.

The CE also estimates angler use of Littleville Reservoir as well as of the Middle Branch of the Westfield River just below the dam. The CE use data are obtained using a system of traffic counters established at entrances to the various fishermen access points. The vehicle counts are expanded by a load factor (people per car) to estimate the number of user days. Occasionally, a day-long survey is made to check the accuracy of the load factor and traffic counter figures (12). The number of man-days of fishing on the reservoir estimated by the CE averaged 34,882 fishermen-days for

the trout angling season (Table 3). When the angling season was extended in 1972, 1973, and 1974, an average of 3,360 additional angler days per year was recorded by the CE. This added fishing effort amounted to approximately 11.6 percent of the total pressure reported by the CE for the three years with extended seasons for which data are available.

Comparison of the MDFG statistics with the CE statistics for the same years (1969, 1970, and 1971) reveals that the CE-developed estimates of angling pressure are consistently higher than those of the MDFG. The average seasonal estimate by the CE for the three years was 33,881 angler trips, whereas the State's average estimate was 12,561 angler trips. The average CE estimate was 2.7 times greater than the average State estimate. It was also apparent that the CE estimates reflected increasing angler-use of the reservoir, while the State's estimates reflected declining angler effort.

Trout have been planted each year in the Middle Branch of the Westfield River, both above and below Littleville Reservoir. The stocking records indicate that an average of 9,360 trout per year were stocked in the Middle Branch. Before 1971, more brook trout were planted than other species, while rainbow trout have comprised about 77 percent of the plants in more recent years. The stocked trout have been distributed more or less evenly over the entire length of the river, except that the 1973 and 1974 plants were all above Littleville Reservoir. By 1973, posting of the privately-owned Middle Branch of the Westfield River below the reservoir had become so widespread that all stocking was terminated.

Angling effort on the river was not measured by the MDFG. The CE's visitation records for the reach of the river immediately below the dam are

Table 2.--Summary of Littleville Reservoir creel survey data (mid-April to mid-October 1968-1971) developed by the Massachusetts Division of Fisheries and Game

Year	Survey period	Angler hours	Angler trips	Number of fish harvested		Weight of fish harvested			
						Trout		Other	
				Trout	Other	(lbs)	(kg)	(lbs)	(kg)
1969	4/19-10/19	43,515	13,222	12,020	232	2,377.5	1,078.4	33.7	15.3
1970	4/18-10/18	45,499	12,966	9,347	1,301	5,231.6	2,373.0	253.5	115.0
1971	4/17-10/17	37,864	11,495	5,477	536	3,046.2	1,381.7	119.1	54.0
AVERAGE		42,293	12,561	8,948	690	3,551.8	1,611.0	135.4	61.4

Table 3.--Annual estimates by Corps of Engineers of fishermen use of Littleville Reservoir for the years 1967 through 1974

Year	Estimated number of fishermen days	
	Trout season (Mid-April to mid-October)	Total year
1967	52,854	52,854
1968	37,358	37,358
1969	24,566	24,566
1970	37,556	37,556
1971	39,521	39,521
1972*	33,340	37,973
1973*	27,573	30,601
1974*	26,285	28,704
Average	34,882	36,142

* Angling season extended through February.

questionable (according to the CE), because the fishermen recorded for the area might have fished either the reservoir or the river. According to the CE records, angling pressure in this area was 937 trips in 1972, and 1,957 trips in 1973. According to MDFG records, however, the stream below Littleville was stocked in 1972 but not in 1973. These particular CE records are not, therefore, considered to provide an accurate portrayal of the angler use of the river below Littleville Reservoir. The CE ceased recording stream fishing at the project in 1974.

A minimum downstream flow release of 5 c.f.s. was provided by the Massachusetts Legislature by passage of Chapter 628, entitled "An Act to Authorize the City of Springfield to Increase Its Water Supply" (9). Release of cold water for benefit of the downstream trout fishery was not provided by the CE.

Fisheries Resources -- Evaluation of Planning Input

Littleville Reservoir (including flood pool) inundated a section of the Middle Branch of the Westfield River which, according to a 1952 MDFG creel survey, supported approximately 530 angler-days per angling season. Prior to project construction, the affected river section was managed as a hatchery-supported trout fishery. The reservoir was also expected to support a trout fishery, and angling use of this new resource was expected to be high. Some 100 angler-days per acre, totaling 27,000 angler-days per year, were predicted for the reservoir fishery. This particular level of use was projected on the basis of the existing use of Comet Pond, a similar though smaller trout pond located near Worcester, Massachusetts.

Creel studies conducted by the MDFG on Littleville Reservoir in 1969, 1970, and 1971, reflected an annual angling pressure which averaged 12,561 man-days. In an artificially-sustained trout fishery, fishing pressure is related to the

intensity of stocking. The average number of trout stocked at Littleville Reservoir was not particularly high at one-half catchable trout per angler-day. If more trout were stocked, increased fishing pressure would undoubtedly have been generated. This relationship of stocking intensity to angling effort was not discussed in the planning documents.

The 1969-1971 angler-use estimates by the CE for Littleville Reservoir, averaged 33,881 angler-days per season. The latter was 2.7 times the MDFG-estimated average of 12,561 angler-days for the same three fishing seasons. The average CE estimate of 33,881 man-days was approximately the level of use predicted by the FWS in the pre-impoundment document. Because the MDFG surveys were specifically designed to assess the sport fishery of Littleville Reservoir, they probably provide the more precise estimates of actual angling use. Assuming this judgment is correct, angler use of Littleville Reservoir based on the hatchery-supported trout fishery, after five years of impoundment, was approximately 47 percent as great as predicted in the pre-impoundment planning document.

The project was not of sufficient size at 111 surface ha (275 ac) to allow significant storage potential for downstream flow augmentation. The desirability of downstream flow augmentation was mentioned in early project-related MDFG correspondence (13). The FWS decided, with MDFG concurrence, that the pool fishery should be favored over the stream fishery. Therefore, their recommendation to the CE was to provide maximum cold water to the one-mile downstream reach without drawing down the pool. Use of a deeper water supply gate was suggested to obtain the cold water. The FWS did not recommend a minimum flow below the project. The 5 c.f.s. minimum flow presently provided by the project resulted from state legislation that authorized

water supply storage at the project for the City of Springfield, Massachusetts.

The FWS recommendation, to release a natural flow up to 100 c.f.s. through the deep water-supply gate (elevation 466), was never implemented by the CE. The CE indicated that this was due primarily to the fact, after the project became operational, that the need for such releases had not been identified or requested by fish and game agencies (12). When contacted in relation to preparation of this evaluative report, the FWS indicated that they were not aware that the requested coldwater releases had not been provided by the project (9). In fact, the follow-up report prepared by the FWS in 1973 (5) erroneously stated that the downstream flow recommendation, including flow release from the elevation 466 gate, had been incorporated into project operation.

Consideration of this particular aspect of project operation received considerable impetus as a result of the present evaluation. Discussions between the CE and the MDPG were initiated and coldwater release below Littleville Reservoir is a definite possibility by 1976 (7).

The Middle Branch of the Westfield River below Littleville Reservoir did not receive adequate consideration during the planning stage of project development. As low-flow augmentation and coldwater releases were not guaranteed provisions of project operations, the MDPG did not seek riparian easements or access development along the one-mile stretch of the Middle Branch between Littleville Dam and the Westfield River. Subsequently, this stretch of river became increasingly posted to the extent it became necessary to curtail completely the trout stocking program in 1973 and 1974.

SUMMARY

Littleville Reservoir is located on the Middle Branch of the Westfield River within the Towns of Chester and Huntington, Massachusetts. The project was authorized in 1958 to provide flood control and water supply benefits. Construction of the dam was initiated in June, 1962, and completed in 1965. At full flood storage, Littleville Reservoir has a storage capacity of $4.0 \times 10^7 \text{ m}^3$ (32,400 ac-ft) and covers 206 ha (510 ac). The water supply pool includes $1.2 \times 10^7 \text{ m}^3$ (9,400 ac-ft) of storage and covers 111 ha (275 ac). Total land and water area at the project is 680 ha (1,680 ac).

This investigation indicated that the fish and wildlife aspects of the Littleville Reservoir project received only perfunctory treatment by the affected State and Federal agencies. Only brief, qualitative fish and wildlife comments were available when the project received Congressional authorization in 1958. The only substantive fish and wildlife planning document prepared by the FWS was submitted to the CE on November 27, 1961, only seven months before project construction began.

In the 1961 document, the FWS anticipated that the direct impact of the project on terrestrial wildlife resources would be insignificant because of the small size of the lake. The FWS stated that the greatest negative impact on wildlife would occur if the project lands were closed to public hunting. The planning report contained the specific recommendation that project lands should remain open for public hunting. Although the possibility of closure of the project lands to hunting was appreciated by the FWS, their report did not contain any alternative wildlife development plans to mitigate wildlife losses in the event this loss actually occurred.

Thus, when the City of Springfield closed the project lands to hunting to avoid possible contamination of their future water supply, there was an unmitigated loss of hunting opportunity on approximately 680 ha (1,680 ac) of habitat associated with the Littleville project.

Prior to reservoir construction, the Middle Branch of the Westfield River within the project site supported a popular trout fishery. The FWS computed a monetary value for this fishery based upon a 1952 MDFG survey that indicated the river in the project area received 156 angler-trips per mile. This figure was multiplied by an assigned angler-day value of \$3.00, providing an estimated pre-project sport fishery valuation of \$486 per mile (total of \$1,215 for the section of river flooded by the reservoir).

The anticipated impact of the Littleville Reservoir project on the area's sport fishery resource received more careful attention during the pre-impoundment planning phase than did the wildlife aspects. The project-associated sport fishery, anticipated for a period of approximately 20 years (or until the lake is tapped for water supply), was described in both quantitative and qualitative terms. The new reservoir was expected to support a trout fishery. Angler-use prediction was based upon creel studies conducted at a similar though smaller trout pond located near Worcester, Massachusetts. According to MDFG studies, this stocked trout pond supported approximately 100 angler-days per acre per year. This same intensity of angler use was anticipated for Littleville Reservoir.

The MDFG creel studies conducted at Littleville Reservoir during 1969-1971 indicated that the anticipated level of angling was not reached in those years. According to the State creel data (collected five to seven years after impoundment), angler use of Littleville Reservoir averaged

46 trips/acre of 46 percent or the predicted level of use. Knowledgeable State personnel indicated that present level of angler use of Littleville Reservoir is probably similar to the 1969-1971 level, with no trend towards increasing utilization.

As would be expected, the creel studies indicated that the quality of fishing and the fishing pressure were determined both by the number of trout planted and the date of stocking. The stocking rate for the three creel survey years averaged around one-half trout (catchable) per angler-day. An increase in the number of trout planted may well have attracted considerably more fishing pressure. The pre-construction angling pressure prediction was not associated with any particular stocking regime.

The CE's estimate of angling pressure (derived from traffic counter information) averaged 2.7 times greater than State estimates for the same periods of analysis. The State surveys were designed specifically to quantify angling intensities and harvest. It would, therefore, seem probable that these state-generated figures would more accurately reflect actual fishing pressure than would the CE extrapolations.

The sport fishery of the Middle Branch of the Westfield River, lying between Littleville Reservoir and the confluence with the Westfield River (a distance of approximately one mile), received no special consideration in conjunction with development of the project. Access easements were not obtained along the river and, over the years following construction, posting became an increasing problem. Streamside posting became so pervasive that trout stocking was eliminated in this section of the river in 1973. Although requested by the FWS in the pre-construction planning report, coldwater releases to enhance the down-stream trout fishery were

not incorporated into the operational procedures for the reservoir. As a result of questions raised during this investigation, the affected agencies have begun communications which may result in coldwater releases by 1976.

Poor communications and cooperation between agencies involved with the Littleville project was apparent from the records at several junctures of planning and post-construction follow-up. During the planning period, the State attempted, unilaterally and unsuccessfully, to obtain from the construction agency a 600-acre wildlife management area. The FWS was not directly involved in this land-acquisition attempt.

The FWS's follow-up program at Littleville also reflected the casual attitude assumed for the fish and wildlife resources at this relatively small project. The FWS reported that their recommendation to permit hunting on project lands and to provide coldwater reservoir releases were incorporated into project operation when, in actuality, neither was adopted. An equally-casual MDFG concurred in the obviously erroneous 1973 follow-up report of the FWS.

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